GIS and geostatistics for modelling urban times in neighbouring border cities*

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1. Introduction

This paper is focused on the study of spatial organization of recreational activities through space and time in the 'twin cities' of Gorizia and Nova Gorica at the Italy-Slovenia border by means of GIS and geostatistical methods. The attention is drawn on the border effect that, due to the enlargement process of European union, is now reducing and becoming more permeable, creating new opportunities of interaction. In particular we try to model the different characteristics of the two cities in terms of locations of recreational activities allowed in the different parts of the cities and in different times of the day. The analysis is developed to explore the recreational business districts (RBD) in the urban environment and is performed from a selection of human activities, geocoded as address points and elaborated through Kernel Density Estimations (KDE). This allows visualizing the functional urban environment with density surfaces and highlighting areas and times of the day where recreational activities and functions concentrate.

2. The study region

2.1 Gorizia and nova Gorica: the border and socio-economic activities

After 1947 the border between Italy and Jugoslavia (today Slovenia) split the city of Gorizia and part of its rural *umland* between two states, leaving most of the urban area under the Italian State and pushing for the development of a new city in Jugoslavia from an initial set of sparse settlements.

As a consequence, Gorizia continued to boost its natural commercial vocation, also developing services for its inhabitants. On the contrary, Nova Gorica invested its efforts in creating a city with clustered activities, concentrating on leisure-oriented ones. The presence of the border created a system of import-export firms, that represented the only common activity between the two cities. With the fall of the border, Gorizia and Nova

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Gorica present similar activities, but people enjoy them in a different way and in different times of the day, thus creating an interchange of flows between the two urban areas.

2.2 Urban planning and structures in Gorizia and Nova Gorica

The new city of Nova Gorica is based on the principles of functionalistic architecture - vertical development of buildings, wide green spaces between built areas and grid structure of the road network. The city centre is not the barycentre but is located along one of the major road axes with activities not directly facing the streets but organized in big 'containers' of several activities as 'open air' shopping centres or malls. Gorizia is an older city, not planned as a 'driven city' but with streets and roads allowing walking and shopping and with business activities facing directly the street front. By observing the spatial distribution of activities, these can be seen as points organized along the main street axes with a direct link with the road network structure.

3. Recreational business district, time and geographical analysis

3.1 Central activities and the Recreational Business District

The central business district (CBD) is studied in urban geography through all the twentieth century and is related to the presence of human activities taking place in the central areas of cities (Haggett, 2000). Many of the indicators studied in the past consider the concentration of central activities, in other cases considering the surfaces occupied by these activities or the heights of buildings (Murphy and Vance, 1954). Other authors stress the differences between day and night population, highlighting working people in central areas during the day and other areas where people in search of leisure and free time concentrate at night.

While the Central Business District indicates an area where central activities concentrate, a Recreational Business District (RBD; Stansfield and Rickert, 1970) can be defined to highlight areas of a city where leisure and recreational activities take place. In many European cities central areas are occupied during the day by activities like retail and services, while at night the central functions are played by the those activities related to leisure.

3.2 Time and recreation

Gorizia and Nova Gorica live different time dynamics. Gorizia is based on retail and business services more concentrated on day life, broken by few hours of closing time at lunchtime, a closing day on Monday and the main time of activities on Saturday afternoon. Nova Gorica is based mainly on casinos and other leisure activities, particularly night clubs. Night people are privileged as well as day workers, as retail activities have generally not lunchtime break although there is an early closing time in the afternoon and shops are closed on Saturday.

3.3 Density analysis in space and time

In order to visualize the variation of activities in different times of the day, the KDE was chosen in order to transform the point datasets in three-dimensional continuous surfaces that allow a better visualization of the clustering of activities, as well as a diachronic comparison of the different time frames.

The KDE function allows estimating the intensity of a point pattern and representing it by means of a smoothed three-dimensional continuous surface that represents the variation of density of point events across the study region (Chainey et al., 2002). In such visualization, peaks represent the presence of clusters or 'hot spots' in the distribution of events.

4. The data

Data were chosen from Yellow pages categories for both the cities of Gorizia and Nova Gorica. They were considered as the more suitable to provide a sample of central recreational activities to characterize urban centres since they reflect the main leisure points for the two cities and given the orientation of Gorizia towards services and Nova Gorica towards recreation.

Data were georeferenced at address point level for the two urban areas and grouped in 8 categories (hotels, bars, restaurants, culture, high street retail, casino and disco, gas stations, theatres and cinemas) were listed and consisted on a total of around 300 locations. It was therefore possible to represent the central activities in a GIS environment and have a first flavour of the pattern of the leisure activities in the study region, highlighting a structural and organizational separation between the two cities created by the State border.

5. Application and results

5.1 The application to the dataset

In order to examine the recreational centres of the two cities a KDE was performed over the datasets obtained for the two cities. It was possible to obtain different subsets of the original data in order to visualize the 'active' activities in different times of a working day. The density estimation was performed on these sub datasets so that it was possible to transform the point data in continuous density functions over the study region, therefore not limited to the single locations of events. A 20m grid was superimposed over the study region so to have a minimal sample unit to store a density value in terms of activities per sq km, distance weighted according to their distance from the sampling point.

A quartic KDE was chosen over a 400m bandwidth as a starting value for the analysis.

5.2 The bandwidth choice

Urban studies usually consider a distance between 300 to 500m as a reference for a good five minutes walk coverage. Such 'walking' thresholds seem to be adequate for the urban area of Gorizia, while for Nova Gorica the bandwidth should be extended, given the different urban structure and accessibility more suitable to private transport. In the present research however we used a same 400m bandwidth for the entire study region. The KDE computed using this distance provide a measure of accessibility, showing for each cell the number of activities that can be reached within a certain distance, weighting more the closer ones than the farther ones.

5.3 First results and conclusions

The analysis produced first results in terms of density of leisure activities in the two urban areas for different times of the day. Results are displayed in fig. 1 and highlight a

general dominance in terms of overall density of existing activities in the Gorizia area (fig. 1a), given also by its bigger dimension as an urban area. Fig. 1b to 1f show the variation of the leisure activity densities in the two cities, both in terms of their locations and availability through time and highlights different living times for the two cities, particularly at nighttimes and during the breaks connected to the working ends (lunch-time and late afternoon).

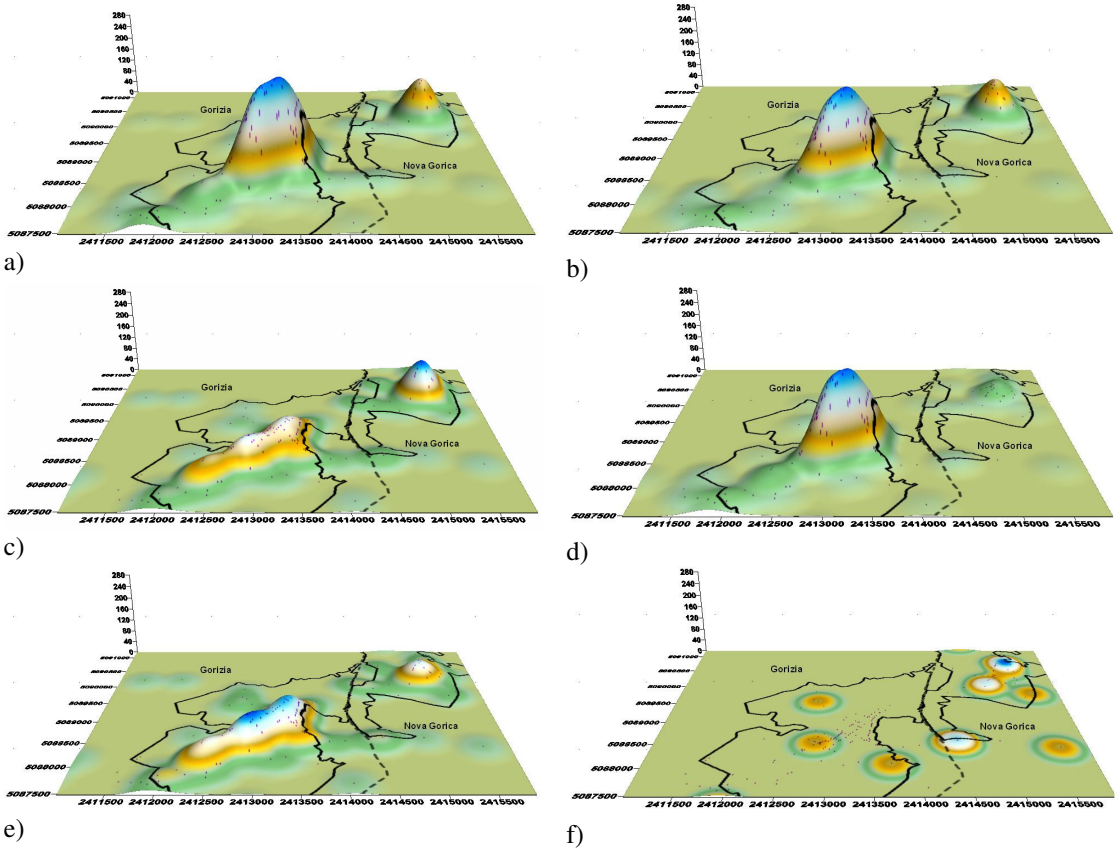

Figure 1. KDE on recreational and leisure urban activities (purple dots), with State border (dashed gray line) and urban areas (black lines): (a) all activities; b) 09.00 AM; c) 01.00 PM; d) 06.00 PM; e) 08.00 PM; f) 0.00 AM

6. Future developments

The research is ongoing to include other activities to be considered in order to compare CBD and RBD extensions. Furthermore, we plan to modify the density searching function in order to take into account the network structure of the two urban areas, both in terms of the distance of the activities considered from the network and in terms of other spatial constrains. These latter in particular are given also by the border access points as organizational elements of the urban structure.

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